POPULATION CHARACTERISTICS OF HUMPBACK WHALES IN GLACIER BAY AND ADJACENT WATERS: SUMMER 1986

C. Scott Baker

Marine Biologist

Glacier Bay National Park and Preserve

Gustavus, Alaska 99826

ABSTRACT

A total of 51 individual whales, including eight calves (15.7%), were identified in the combined areas of Glacier Bay and Icy Strait during the summer of 1986. Of this total, 16 were found only in Glacier Bay, 19 only in Icy Strait, and 16 were common to both areas. Twelve whales, including one calf, were resident in Glacier Bay for periods of at least three to four weeks each. During early and mid-June, whales were found predominantly in the waters between Leland and Garforth Islands. During late June and throughout July, as many as 20 individual whales congregated in the lower bay, particularly along the western shore near Point Carolus and in Bartlett Cove. All but a few whales departed the bay suddenly in early August and moved into the adjacent waters of Icy Strait. Throughout the summer, the primary prey of humpback whales in Glacier Bay was schooling fish, particularly capelin, Mallotus villosus. The sudden departure of the whales from the bay during early August was associated with an apparent decline in the availability of schooling fish. Eight whales, first sighted in Glacier Bay or Icy Straight, were later sighted in Frederick Sound, and one whale, first sighted in Frederick Sound, was later found in Icy Strait. Whales in Glacier Bay were more gregarious, and whales in Icy Strait were more solitary, than in previous study years. One case of apparent juvenile mortality was documented. The abundance and crude birth rate of whales in Glacier Bay has followed a cycle of alternating high and low years for the past five summers.

INTRODUCTION

In the years prior to 1978, as many as 24 whales entered Glacier Bay and remained there to feed for a substantial part of the summer. In 1978, however, 17 of the 20 whales that entered the bay abruptly departed soon after their entry. Two hypotheses were advanced to explain this sudden departure. The first asserted that vessel traffic disturbed the behavior of whales and that the exponential increase of vessel traffic in Glacier Bay during the years prior to and including 1978 forced the whales to "abandon" the bay. The second hypothesis proposed that the whales' departure was the result of a natural decline in the availability of their prey within Glacier Bay.

In 1981 the National Park Service, with the consultation of the National Marine Mammal Laboratory, initiated a multidisciplinary study of humpback whales to help determine the reasons for their sudden departure in 1978. Studies of the acoustic environment and behavior of humpback whales demonstrated predictable short-term changes in their movement and respiration as a function of vessel traffic and noise (Baker et al. 1982; Baker et al. 1983; Dean et al. 1985; Malme, Miles, and McElroy 1982; Miles and Malme 1983). The assessment of humpback whale prey showed considerable seasonal and yearly variation in the abundance and primary species of prey in Glacier Bay, as well as a correlation in prey availability and whale distribution in other areas of southeastern Alaska (Wing and Krieger 1983; Krieger and Wing 1984; Krieger and Wing 1986).

Although these studies have corroborated some aspects of both hypotheses, they have not yet demonstrated conclusively the reasons for

the whales' departure from the bay in 1978. Given the absence of data on prey abundance prior to 1978 and the difficulty in experimentally determining the levels of vessel activity that could result in abandonment of a habitat, the exact cause of the 1978 departure may never be entirely resolved. Nonetheless, the studies initiated and funded by the National Park Service have answered many questions concerning the behavior and ecology of humpback whales in Glacier Bay and throughout southeastern Alaska (Baker et al. 1985; Baker et al. 1986). It seems certain that these data will be of long-term value to the management of humpback whales in southeastern Alaska and throughout their migratory range.

Here I summarize the results of the ongoing monitoring of humpback whales in Glacier Bay and Icy Strait during the 1986 summer season. This summary provides an additional yearly contribution to one of the longest time-series of data available for a population of living baleen whales (Baker 1985, 1983; Perry et al. 1985; Jurasz and Palmer 1981).

METHODS

Vessel Surveys

Humpback whales were observed and photographed from a 17-foot Boston Whaler powered by a 50-hp Johnson outboard motor. Surveys for whales in Glacier Bay usually included the entire lower and mid-bay to Sturgess Island or Geike Inlet. Several of the surveys reached as far into the east arm as Point George and as far into the west arm as Lamplugh Glacier and Tarr Inlet. Surveys for whales in Icy Strait were generally confined to the waters just outside of the bay's mouth and the coastline a few

miles east and west of Point Adolphus on Chichagof Island. Two surveys also included the mouth of Excursion Inlet and the length of Icy Passage from Point Adolphus to the confluence of Chatham Strait.

Humpback whale surveys in Glacier Bay were conducted on 13 days during June, 17 days during July, and 6 days in August, 1986 (Table 1). Surveys in Icy Strait were conducted on five days in June, three days in July, six days in August, and two days in early September. In most cases, the number of surveys in each area was limited to two or three a week to minimize any possible impact that the monitoring program might have on the whales. During July, however, the large number of whales in Glacier Bay sometimes required surveys on several consecutive days in order to identify most of the animals.

In addition to the surveys of Glacier Bay and Icy Strait, three surveys of Frederick Sound and Stephens Passage were completed with the assistance of the Auke Bay Laboratory of the National Marine Fisheries Service. In recent years, there has been a pattern of late-summer movement of whales into this area from Glacier Bay and Icy Strait (Baker et al. 1983; Baker 1984; Baker et al. 1985; Perry et al. 1985; Perry and Baker 1986). One of the goals of the surveys outside of the park was to continue documentation of this seasonal trend in regional movement. Another goal of these surveys was to continue assessment of humpback whale populations in areas of southeastern Alaska that may be impacted indirectly by vessel activity in Glacier Bay National Park. The Park Service's continued monitoring of the southeastern population was strongly recommended by the 1983 biological opinion of the National Marine Fisheries Service (Anonymous 1984).

Photo-Identification

Photographs were taken with high speed (ASA 400) black and white film using a Canon A1 camera equipped with a motor-drive and a 70 to 205-mm zoom or a 300-mm telephoto lens. In all cases I attempted to obtain clear photographs of the dorsal fin and the ventral surface of each whale's tail flukes for the purposes of individual identification (Katona et al. 1979). These individual identification photographs were then compared to available photographs (Perry et al. 1985) to determine the past sighting history of each whale. Individual whales are referred to by an identification number from the University of Hawaii's Kewalo Basin Marine Mammal Laboratory catalog. Individuals previously identified by Jurasz and Palmer (1981) are also cross-referenced to their previously assigned nicknames. Whales not known to have been previously photo-identified are designated by a code refering to the area and sequence of their sighting. For example, ais-02 was the second previously unidentified animal sighted at Icy Strait this summer. Further details of the photo-identification methods can be found in Perry et al. (1985) and Baker et al. (1985).

Prey Assessment

Prey abundance in the vicinity of feeding whales was qualitatively assessed with a Ross Fineline 250-C, recording fathometer equipped with a 22-degree beam, 100-khz tranducer. This frequency transducer was chosen, based on consultation with Ken Krieger of the Auke Bay Laboratory, in order to allow the discrimination of both fish and planktonic targets in

the upper 150 m of water. The sensitivity (set at 7) and the paper speed (set at 2) of the fathometer were standardized, except where noted, to allow for qualitative comparison to previous years and across sampling episodes.

Quantitative hydroacoustic assessment of whale prey was conducted during three surveys conducted by Ken Krieger using methods and equipment comparable to those used in previous years (Wing and Krieger 1982; Krieger and Wing 1984). These results of these surveys will be summarized elsewhere.

RESULTS AND DISCUSSION

Abundance

A total of 51 individual humpback whales were identified in the combined areas of Glacier Bay and Icy Strait during the summer of 1986 (Table 2). Of this total, 16 individuals were sighted only in Glacier Bay, 19 were sighted only in Icy Strait and 16 were sighted in both areas. This is the largest number of whales recorded in these areas since systematic surveys were begun in the early 1970's (Anonymous 1984; Perry et al. 1985).

Restricting the photo-identification sample to the months of July and August, a period comparable to the shorter sampling period in most earlier years (Perry et al. 1985; Baker 1985a), would result in a count of 26 whales sighted in the bay and 27 whales sighted in Icy Strait. Even in this restricted sampling period, the counts are slightly higher than any previously documented.

The 1986 summer season is the fifth season during which comparable information on whale abundance has been collected in the Glacier Bay - Icy Strait area (Baker 1985a; Perry et al. 1985). A summary of this data (Table 3) shows that the number of whales entering Glacier Bay has followed a two-year cycle of alternating high and low counts. The statistical significance of this two-year cycle can be tested by considering the probability of encountering such a regular cycle by chance, regardless of the magnitude of the cycle. Given that the first year (1982) of the cycle was high, the probability of the four subsequent years following a regular alternating cycle by chance is 0.06 (0.5 x 0.5 x

0.5 x 0.5 = 0.06), slightly above the 0.05 level of probability considered to be significant in most statistical tests. An additional year of censusing, if in agreement with the prediction of a low count, would reduce this probability to 0.03 and provide a persuasive argument for a naturally occuring two-year cycle of whale usage in the bay. The underlying environmental, biological, or social causes of this apparent cycle, however, remain unknown.

Seasonal Influx and Distribution

Glacier Bay. Few, if any whales, were present in Glacier Bay during May. A May 22 survey found no whales and a May 27 survey of the lower bay found only one whale, Quits (#535), moving south past Anacon Rock. During early June, four to six whales moved into the bay and concentrated their activity in the waters between Leland and Garforth Islands (Figure 1a). The number of whales in the bay increased suddenly during late June, and by mid-July as many as 20 whales were clustered along the shoreline from Point Carolus to Berg Bay and in the mouth of Bartlett Cove (Figure 1b). The majority of whales departed the bay suddenly in late July and only two whales were sighted during surveys of the bay in August (Figure 1c). The maximum number of whales sighted in Glacier Bay during a single survey was 17 on July 22.

Icy Strait. The seasonal influx in Icy Strait complemented that of the bay. About eight whales, including many of the former Point Adolphus "core group" (Perry et al. 1985), were found near Point Adolphus during late May and early June (Table 2). In late June and during much of July many of these whales moved into the bay leaving only a few whales

remaining near Point Adolphus. In early August these whales and some other late-season arrivals returned to Point Adolphus and remained throughout the month. The maximum number of whales sighted near Point Adolphus during a single survey was 14 on both August 8 and August 18.

Local Movement and Residency

Sixteen whales were identified in both Glacier Bay and Icy Strait. Ten of these whales made one or more roundtrips (i.e. moved from one area to the other and back). As described previously, the large interchange between the two areas was the result of the whales moving into the bay from Point Adolphus during July, and back to Point Adolphus in August. This pattern is evident in the movement of Garfuncle, Scoper, Frenchie, Leigh, and #351 (Table 2). Given this frequency of movement between Glacier Bay and Icy Strait, it was not always possible to determine the residency of an individual in the bay. In fact, the facility with which individuals utilize either area in the same or alternate years, argues against the validity of the "residency" measurement.

Nonetheless, it was possible to determine, with reasonable certainty, that 12 individuals were resident in the bay for periods of at least three weeks (Table 4). One whale, Quits, was resident in the bay for over eight weeks and Chop Suey was resident for over six weeks. At least one of the resident whales, however, made a brief excursion from the bay into Icy Strait; Round-Up Taylor was sighted once at Point Adolphus on July 8 but appeared otherwise to have remained in the lower bay. Given the proximity of the lower bay to Icy Strait it is possible that other whales briefly left the bay unobserved.

Prey Assessment and Foraging Strategies

Glacier Bay. The predominant prey of humpback whales in Glacier Bay was small schooling fish. During June and July, dense schools were often visible at the surface making it possible to identify most of the fish as capelin, Mallotus villosus. Later in the summer, however, sandlance, Ammodytes hexapterus, could be seen intermingling with the capelin suggesting that subsurface schools may have contained other species of "bait" fish as well.

During June, whales were typically found feeding on relatively small schools or "balls" of fish patchily distributed along the shores of Leland, Sturgess, and Garforth Islands. On June 9, for example, Spot (#235) was browsing along the 10 fathom shoal on the south tip of Leland Island. Fathometer recordings from the whale's path show a scatter of prey in the upper 10 fathoms and intermittent balls of fish at the surface and extending to near the bottom (Figure 2). It was possible to identify some of the near-surface schooling fish as capelin. The identity of the prey scattered in the upper 10 fathoms, however, is unknown. Two days later, on June 11, Spot was observed near-surface feeding in Beartrack Cove. Fathometer recordings again showed a scatter of prey in the upper 10 fathoms (Figure 3). On this occasion, the scatter of unknown prey seemed to be the primary target of the feeding whale.

Feeding on euphausiids was confirmed, with reasonable certainty, only once during the summer of 1986. On June 9, Chop Suey was observed surface-lunge feeding near Garforth Island. Fathometer recordings showed a scatter of prey in the upper 10 fathoms similar to that seen near Leland

Island and in Beartrack Cove (Figure 4). In addition to lunge-feeding at the surface, Chop Suey dived several times over a subsurface layer of what appeared to be euphausiids centered between 35 and 40 fathoms in depth.

During late June and throughout July, the center of feeding activity shifted to the lower bay, particularly the west shore near Point Carolus and the mouth of Bartlett Cove. Feeding concentrated on extensive and relatively stationary schools of fish, visually identified, in a few cases, as capelin. On July 3, for example, a single whale (#221), was near-surface feeding along the shore about 3 km north of Point Carolus. Fathometer recordings showed a dense school of capelin extending from the surface to the bottom at 10 fathoms (Figure 5). By July 8, five or more whales could be found feeding on the dense concentrations of schooling fish just inside of Point Carolus. Similar concentrations of prey and whales appeared in Bartlett Cove at about the same time. On July 14, Quits, #155, and #351 were feeding together along the shore near the mouth of Bartlett Cove. Again, fathometer recordings from their path showed dense concentrations of schooling fish (Figure 6). On this same date, at least four other individuals were feeding nearby in the cove.

The abrupt decline in the number of whales in the bay during late July coincided with an apparent departure or decline in the availability of schooling fish. At this time fathometer recordings from Bartlett Cove and the Point Carolus area showed only scattered tracings of schooling fish (Figure 7).

In recent years (1981 to 1985), solitary, sub-surface feeding or browsing was the predominant, though not unanimous (see Baker 1985a), foraging strategy of whales in Glacier Bay. During the summer of 1986,

however, a substantial percentage of whales were found feeding in coordination with one or more companions. Although similar coordinated feeding was observed in Bartlett Cove during 1982, this foraging strategy was more typically observed near Point Adolphus in most years. There was also an increased frequency, this year, of surface-lunge feeding by whales in the bay. In years prior to 1978, surface-lunge feeding and bubble-netting were commonly reported strategies of whales feeding on euphausiids in the bay (Jurasz and Palmer 1981). In 1986, however, no bubble nets were observed and, as described previously, it was generally possible to determine that the prey taken during surface feeding was schooling fish rather than euphausiids.

Icy Strait. The foraging behavior of whales at Point Adolphus contrasted with that observed in previous recent years (1981 to 1985), and like changes in distribution, showed seasonal changes that complemented those in the bay. During June and July, when abundance was low, whales were generally solitary. Prey layers, although of still considerable density, seemed less extensive and continuous than in previous years (Figure 8). Some intermittent surface-lunge feeding was observed throughout the summer, a foraging strategy that was rare in previous years. As the number of whales at Point Adolphus increased during August, coordinated feeding by three or four members of the "core group" became more common and layers of prey seemed to become extensive (Figure 9).

Net tows and hydroacoustic assessment in 1983 and 1984 showed that the predominant prey at Point Adolphus was adult herring, Clupea harengus, (Krieger and Wing 1984; 1986). It seems likely, however, that changes in the foraging strategies of whales near Point Adolphus during 1986 were the

result of some changes in the species or age composition of available prey in this areas, as well as in nearby Glacier Bay.

Regional Movement

A preliminary analysis of photographs collected in other areas of southeastern Alaska documented eight cases of movement from Glacier Bay - Icy Strait to Stephens Passage and Frederick Sound (Table 2). The regional movement of these whales was also accompanied by a change in their primary prey; shifting from schooling fish in Glacier Bay - Icy Strait during June and July, to euphausiids in Frederick Sound during August. These observations corroborate the seasonal pattern of regional movement and foraging behavior discussed by Baker et al. (1985).

One individual, #196, (case #47, Table 2) was sighted first in Frederick Sound on July 31 and near Point Adolphus eight days later on August 8. This is the first documentation of movement from Frederick Sound into the Glacier Bay-Icy Strait area since 1981 (Baker et al. 1982).

Recruitment

Recruitment measures a population's net increase. Factors determining recruitment include birth rates, age of first reproduction, juvenile mortality, and adult mortality. Long-term sighting histories of individual whales are currently the only method for determining recruitment in populations of humpback whales. Each summer's observations of the individual whales in Glacier Bay -Icy Strait provides another contribution to one of the longest time series of this data available for

any baleen whale.

Birth Rates. Of the 51 whales identified in Glacier Bay - Icy Strait during 1986, 8 (15.7%) were calves (Table 2). This compares to a crude birth rate of 4.5% in 1985, 17.9% in 1984, 0.0% in 1983, and 18.2% in 1982 (Baker 1985a; Perry et al. 1985). The cyclical changes in crude birth rates for the combined Glacier Bay - Icy Strait area coincide with the changes, discussed previously, in the abundance of whales in Glacier Bay; years of high crude birth rates were also years of high whale counts in the bay.

Juvenile Survival and Mortality. Some whales, first identified as calves (animals less than one year of age) continue to return to southeastern Alaska as juveniles or adults. Animal #186, the calf of Leigh (#236) in 1982, returned to Glacier Bay in 1984, 1985, and 1986. Garfuncle (#516), first identified in Glacier Bay as a calf in 1974, returned to this area in 1986 for the twelth consecutive year. Animal #198, the calf of Max (#539) in 1982, has been sighted subsequently in other areas of southeastern Alaska as a two- and three-year old but has not returned to Glacier Bay - Icy Strait (Baker et al. 1986).

One apparent incident of juvenile mortality was documented during the summer of 1986. Gertrtude (#587) was accompanied by a calf in Glacier Bay during much of June. The calf was small, about 3 meters in length, and had a grey discoloration along its back and dorsal fin, possibly indicating a skin infection. Gertrude and her calf were not observed during July. In August, however, Gertrude was found, unaccompanied by her calf, near Point Adolphus, where she remained for the remainder until September. Given its small size, the calf's disappearance cannot be

explained as a case of early weaning. Although the exact cause is unknown, it seems more likely that the calf died. To my knowledge, this is the first documented case of juvenile mortality in southeastern Alaska.

Age of First Reproduction. No individual whale of known age (i.e. an individual first identified as a calf) has returned to Glacier Bay or elsewhere in southeastern Alaska with a calf of its own. In the northwestern Atlantic, Clapham et al. (1985) documented, through individual identification, the birth of a calf to a five-year old. This is about half of the estimated age of first reproduction accepted by most authors (Johnson and Wolman 1984; Lockyer 1984).

Adult Mortality. There has been no positive confirmation of the death of an individually identified humpback whale in southeastern Alaska. The few whales reported dead and stranded during recent years have not been indivividually identified. The possible death of an individual, however, could be inferred from a persistent failure to resight, across several years, a past resident whale. Notchback (#565), for example, a very uniquely and obviously marked whale, has not been sighted in southeastern Alaska or elsewhere since 1982. Future population monitoring should attend to such sighting lacunae with the eventual goal of quantifying adult mortality and lifespan.

LITERATURE CITED

Baker, C.S. 1983. Humpback whales in Glacier Bay: 1983 season. Final report to the National Park Service, Anchorage, Ak. 21 pp.

Baker, C.S. 1984. Population characteristics and feeding behavior of humpback whales in southeastern Alaska during 1984. Report to the National Marine Fisheries Service, Auke Bay, Ak. 44 pp.

Baker, C.S. 1985 (a). The humpback whales of Glacier Bay and adjacent waters: Summer 1985. Final report to the National Park Service, Gustavus, Alaska 25 pp.

Baker, C.S. 1985 (b). Population structure and social organization of humpback whales (Megaptera novaeangliae) in the central and eastern North Pacific. Doctoral Dissertation, University of Hawaii, Honolulu, HI.

Baker, C.S., and L.M. Herman. 1984. Aggressive behavior between humpback whales, Megaptera novaeangliae, wintering in Hawaiian waters. Can. J. Zool. 62:1922-1937.

Baker, C.S., L.M. Herman, B.G. Bays, and W.S. Stifel. 1982. The impact of vessel traffic on the behavior of humpback whales in Southeast Alaska: 1981 season. Report to the National Marine Mammal Laboratory, Seattle, Wa. 39 pp.

Baker, C.S., L.M. Herman, B.G. Bays, and G.B. Bauer. 1983. The impact of vessel traffic on the behavior of humpback whales in Southeast Alaska: 1982 season. Report to the National Marine Mammal Laboratory, Seattle, Wa. 31 pp.

Baker, C.S, L.M. Herman, A. Perry, W.S. Lawton, J.M. Straley, and J.H.

Straley. 1985. Population characteristics and migration of humpback whales in southeastern Alaska. Marine Mammal Science 1(4).

Baker, C.S, L.M. Herman, A. Perry, W.S. Lawton, J.M. Straley, A.A. Wolman, H.E. Winn, J. Hall, G. Kaufman, J. Reinke, and J. Ostman. 1986. The migratory movement and population structure of humpback whales (Megaptera novaeangliae) in the central and eastern North Pacific. Marine Ecology - Progress Series 31:105-119.

Clapham, Phillip J., Charles A. Mayo, Irene Seipt, and Carole A. Carlson. 1985. Humpback whale mothers and calves on Stellwagen Bank, Massachusetts: 1979-1985. Sixth Biennial Conference on the Biology of Marine Mammals, Boston, MA. Abstracts.

Dean, F.C., C.M. Jurasz, V.P. Palmer, C.H. Curby and D.L. Thomas. 1985. Analysis of humpback whale (Megaptera novaeangliae) blow interval data: Glacier Bay, Alaska, 1976-1979. Final report on Contract CX-9000-0-E099 to the National Park Service, Anchorage, Ak.

Jurasz, C.M. and V.P. Palmer. 1981 (a). Censusing and establishing age composition of humpback whales (Megaptera novaeangliae) employing photodocumentation in Glacier Bay National Monument, Alaska. Report to the National Park Service, Anchorage, Ak. 44 pp.

Jurasz, C.M. and V.P. Palmer. 1981 (b). Distribution and characteristic responses of humpback whales (Megaptera novaeangliae) in Glacier Bay National Monument, Alaska. Report to the National Park Service, Anchorage, Ak. 85 pp.

Katona, S, B. Baxter, O. Brazier, S. Kraus, J. Perkins, and H. Whitehead. 1979. Identification of humpback whales by fluke photographs, pp. 33-44. In H.E. Winn and B.L. Olla (eds.) Behavior of marine animals,

vol. 3. Plenum Press, New York, Ny.

Krieger, K. and B.L. Wing. 1984. Humpback whale prey studies in Southeast Alaska, summer 1983. Northwest and Alaska Fisheries Center, Auke Bay Laboratory, Auke Bay, Ak. 42 pp.

Krieger, K. and B.L. Wing. 1986. Hydroacoustic monitoring of prey to determine humpback whale movements. NOAA Technical Memorandum NMFS F/NWC-98. 62 pp.

Malme, C.I., P.R. Miles, and P.T. McElroy. 1982. The acoustic environment of humpback whales in Glacier Bay and Frederick Sound/Stephens Passage, Alaska. Report to the National Marine Mammal Laboratory, Seattle, Wa. 120 pp.

Perry, A., C.S Baker, and L.M. Herman 1985. The natural history of humpback whales (Megaptera novaeangliae) in Glacier Bay. Final report to the National Park Service, Anchorage, Ak. 41 pp.

Miles, P.R. and C.I. Malme. 1983. The acoustic environment and noise exposure of humpback whales in Glacier Bay, Alaska. Report to the National Marine Mammal Laboratory, Seattle, Wa. 74 pp.

Tyack, P. and H. Whitehead. 1983. Male competition in large groups of wintering humpback whales. Behavior 83: 132-154.

Wing, B.L. and K. Krieger. 1983. Humpback whale prey studies in Southeast Alaska, summer 1982. Northwest and Alaska Fisheries Center, Auke Bay Laboratory, Auke Bay, Ak. 60 pp.

Table 1

Summary of humpback whale surveys in Glacier Bay - Icy Strait: Summer 1986.

Survey Date		Total Whales Sighted Glacier Bay	Icy Strait
MAY	22		4A
	26	0	
	27	1A	5A
JUN	4	4A	
	5		7A
	6	2A	
	9	4A	
	10		6A/1c
	11	5A/1c	
	12		8A/1c
	13	2A	
	15	7A/1c	
	16	2A	
	18		7A/1c
	19	3A	
	20	5A/1c	
	24	3A	
	25	3A	
	26		3A/1c
	28	4A/1c	
	30	8A/1c	

(Continued)

Table 1

(continued)

Survey Date	Total Whales Sighted Glacier Bay	Icy Strait
JUL 1	2A	
3	5A/1c	
6	5A/1c	
8	7A	7A
10	3A/1c	
12	3A	
13	7A/1c	
14	7A	
15	7A/1c	
16	10A/1c	2A/1c
17	6A/1c	
19	10A/3c	
21	8A/1c	
22	14A/3c	
24	2A	
25		8A/1c
28	4A/1c	
29	1A	
AUG 5		5A/1c
6	0	
7		4A/1c
8		12A/2c
11	0	
14	1A	8A/1c
15	0	
18		12A/2c
20	0	
21		7A/1c
25	0	
SEP 2		7A/2c
10		8A

Note: A = adults c = calf

Table 2

Resight histories of whales photographed in Glacier Bay and Icy Strait: Summer 1986.

Note: g = Glacier Bay i = Icy Strait f = Frederick Sound
C = cow j = juvenile

(continued)

ID	May 22	28	June 3	9	15	21	27	July 3	9	15	21	27	August 2	8	14	20	26	1
1. 516	i	i		i	i			gi	gg				ii	i	i			
2. scoper	i		i	ii	i			gg	gg	gg	i		i		i			
3. french	i		i	ii	i		g	i					ii	i	ii			
4. leigh	i		i	ii	i		ggg	ggg	g	ggg	g		ii	i	ii			i
5. less.		i							g					g				
6. 584		i											i					
7. chop s.		i	gg	g	ggggg			g		gg				i				gi
8. md		i		i	ii	i	i		i	g				i		ii		
9. quits		g	g	gggg				g		ggg		gggi						
10. spot			gg	gg	g	g	g											
11. agb-2			g	g	g													
12. ais-2			i															
13. 581			i					i		g					i			
14. ais-4			i															
15. 351				ii	g	g	g	g		g	g	g	i	i		ii		i
16. ais-5 (C) 193				ii	i													
17. calf 1075				ii	i													
18. gertrude (C)				g	g	g							i	i	i	i		i
19. calf				g	g	g							-	-	-	-		-
20. agb-3				gi						g	i							
21. agb-4 (j)				g		ggg		g		ggg								
22. white eyes: 117					g	g	g	g		g	gg	i						f
23. 441					g	g												
24. 155					i		g	gggg		gg								f
25. r.u. taylor						g	g	g	i	ggg								
26. 530 (C)						i			i							ii		i
27. calf						i			i							ii		i
28. ais-6						i												
29. bmw (C)						gg	gg		g	g		f						f
30. calf						gg	gg		g	g		f						f
31. 350						g	g		g	g								f
32. 221							g	g	g	g	g							f
33. 219							i			i			i	i	i			
34. ais-10							i											
35. agb-10 (C)								g	g	gg								
36. calf								g	g	gg								
37. 262									g	g								
38. 455									i									
39. 566 (C)									gg	g	g							f
40. calf									gg	g	g							f
41. 160									g	g								
42 186										gg	i		i	i		i		i
43. agb-12										g								
44. 573 (C)											i		iii		i	ii		i
45. calf											i		iii		i	ii		i
46. ~~ais-12~~ 117 again											i							
47. 196												f	i					
48. ais 15 (C)													i					
49. calf													i					
50. ais-16															i	i		
51. ais-17																i		

Table 3

The standardized and total abundance (in parentheses) of humpback whales (adults and calves) identified in Glacier Bay and Icy Strait: 1982 to 1986.

	Standardized Abundance				
	1982	1983	1984	1985	1986
Glacier Bay	22 (22)	10 (10)	24 (25)	10 (15)	26 (32)
Icy Strait	15 (15)	9 (9)	21 (22)	19 (30)	27 (35)
Combined	33 (33)	17 (17)	39 (39)	27 (41)	42 (51)

Note: Standardized abundance refers to the number of whales sighted during a standardized sampling period of early July to mid-August used in years prior to 1985 (Perry et al. 1985).

Table 4

The interval of residency for whales in Glacier Bay: Summer 1986.

Case	ID	First Day	Last Day	Interval (days)
1.	Quits	May 26	July 24	59
2.	Chop Suey	June 4	July 21	47
3.	agb-04	June 11	July 17	36
4.	#351	June 15	July 28	43
5.	White Eyes	June 15	July 22	37
6.	Leigh	June 25	July 28	33
7.	R.U. Taylor	June 25	July 22	27
8.	BMW (C)	June 18	July 22	24
9.	calf	June 18	July 22	24
10.	#155	June 30	July 24	24
11.	#350	June 30	July 21	21
12.	#221	July 3	July 29	26

Figure 1a

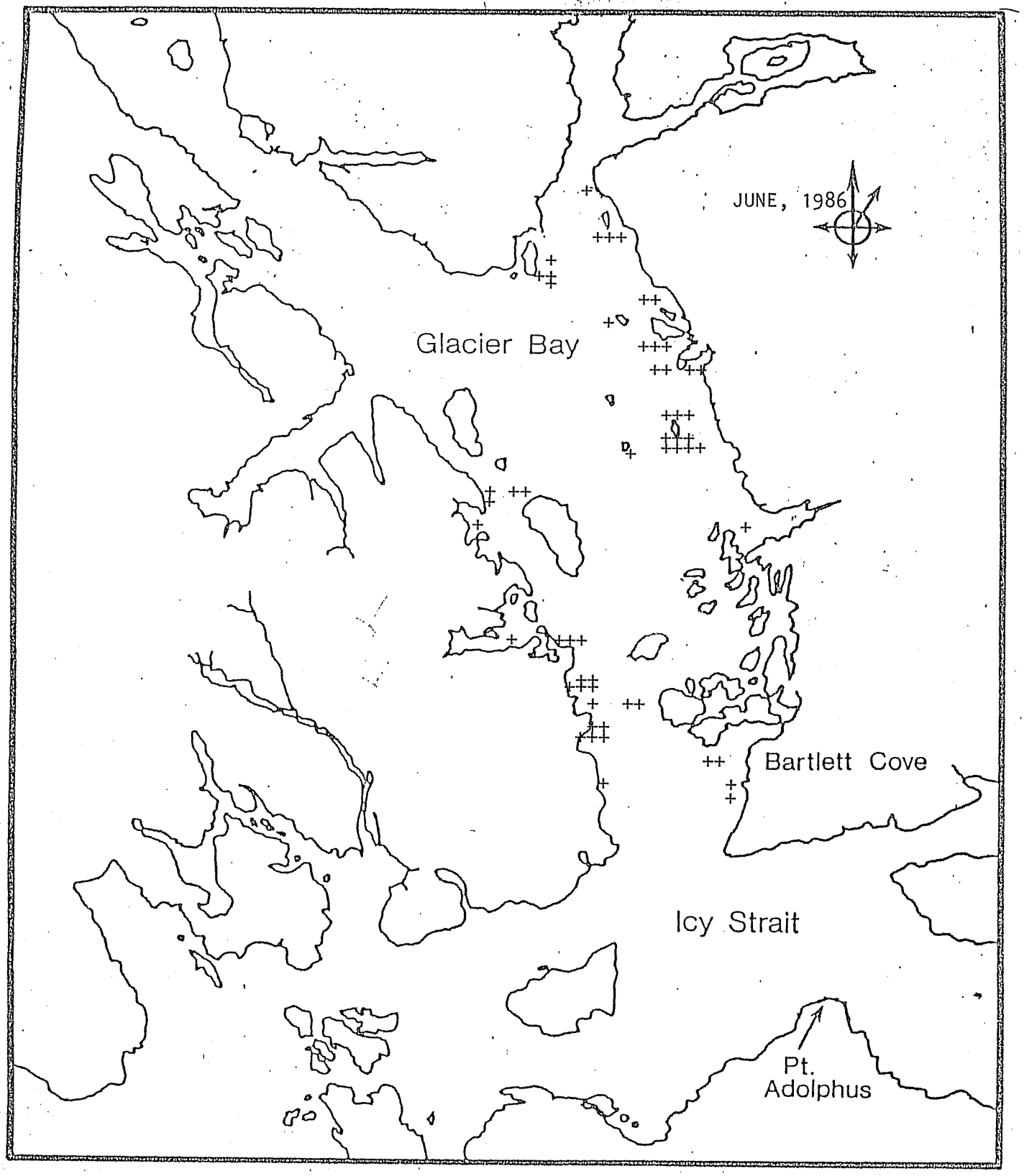

Figure 1b

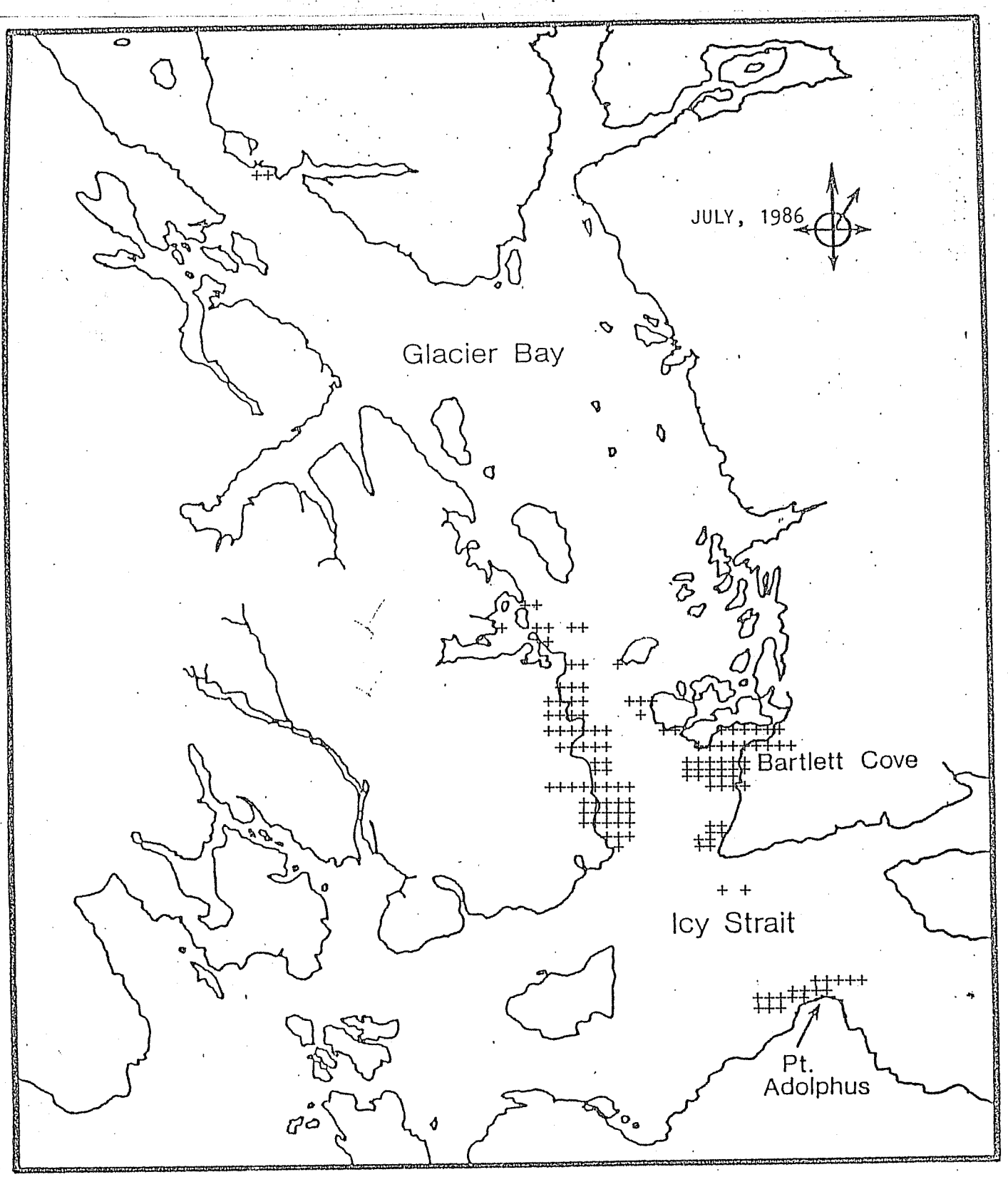

Figure 1c

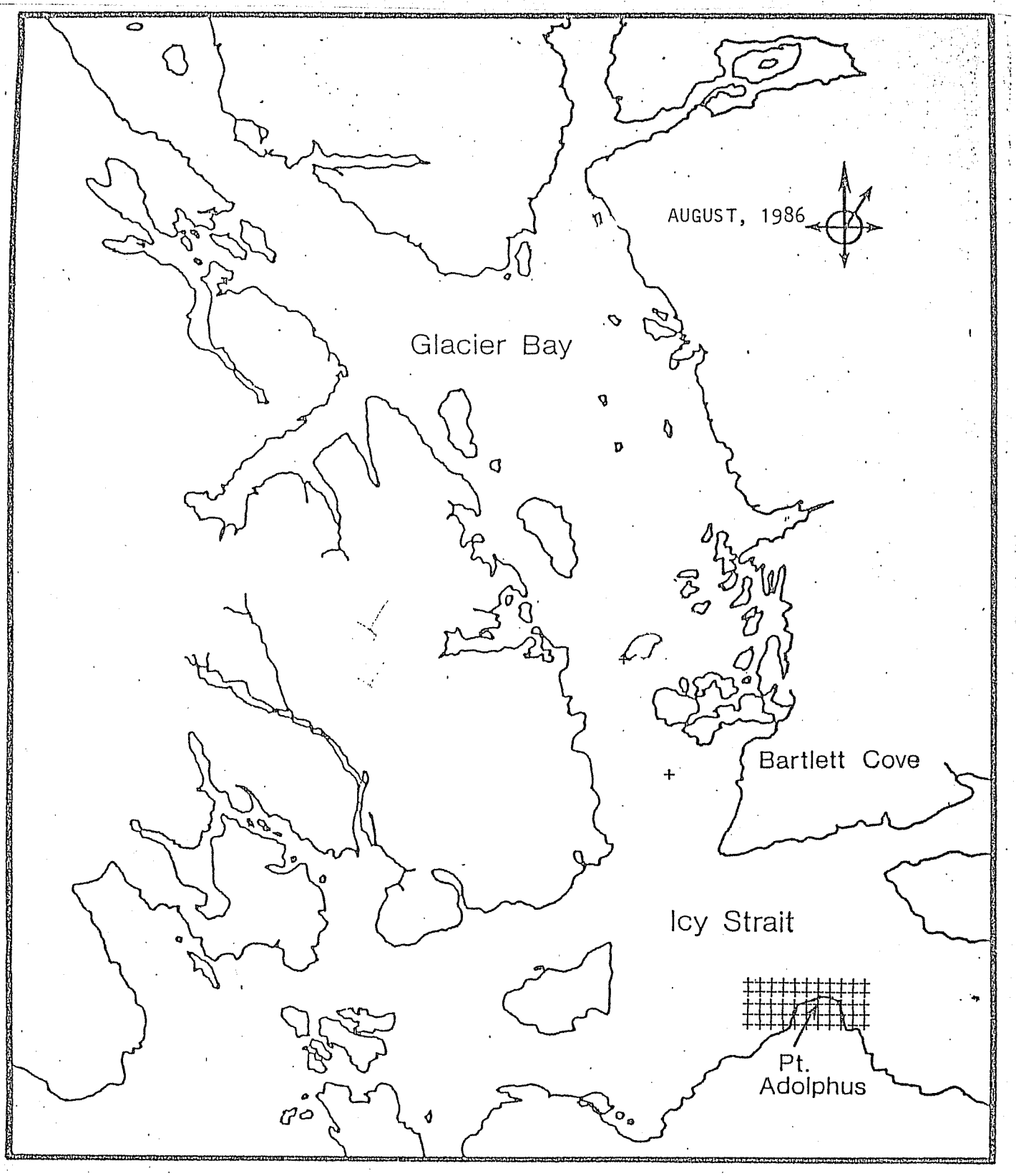
AUGUST, 1986
Glacier Bay
Bartlett Cove
Icy Strait
Pt.
Adolphus

Figure 2: Fathometer recording from the path of Spot near Leland Island on June 9, 1986. Scale 0 to 50 fathoms and gain set at 7. Note the double bottom caused by the echo of the transducer signal.

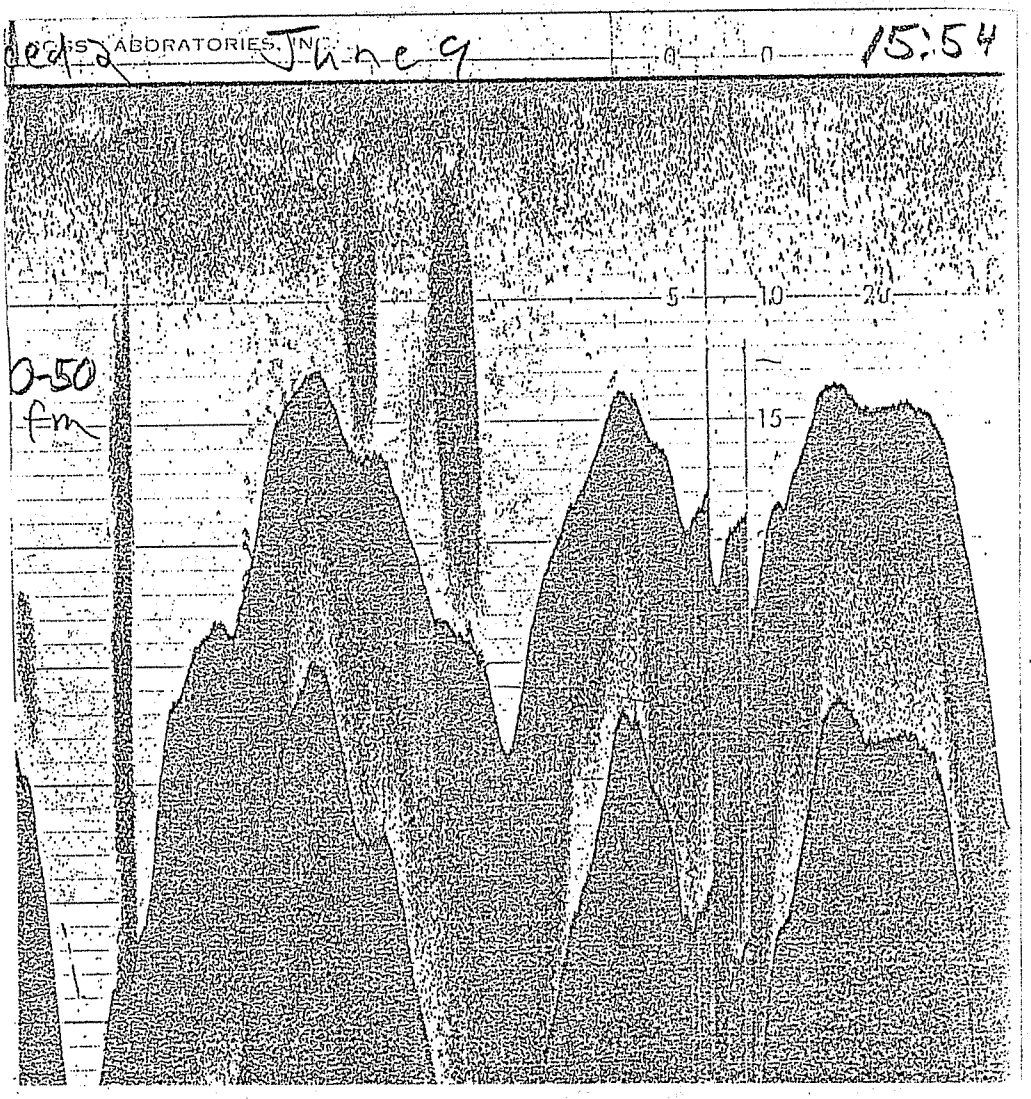

Figure 3: Fathometer recording from the path of Spot in the mouth of Beartrack Cove on June 11, 1986. Scale 0 to 50 fathoms and gain set at 7.

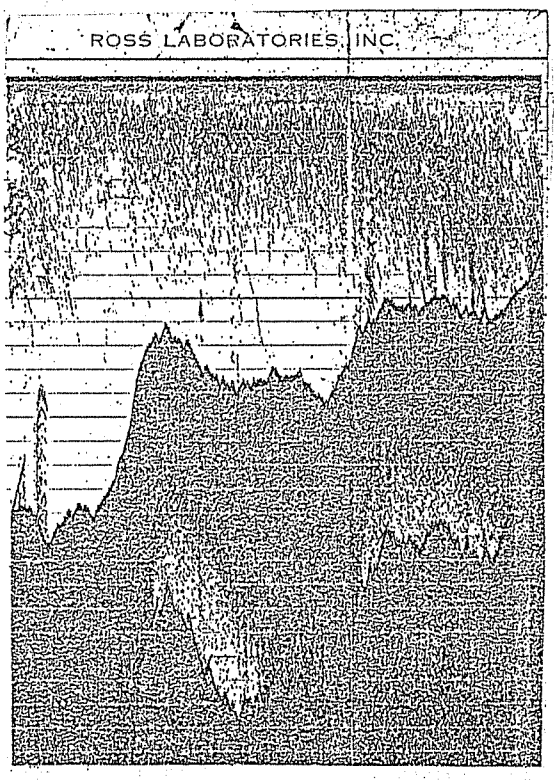

Figure 4: Fathometer recording from the path of Chop Suey near Garforth Island on June 9, 1986. Scale 0 to 100 fathoms in first panel and 0 to 50 fathoms in the second panel. Gain set at 7.

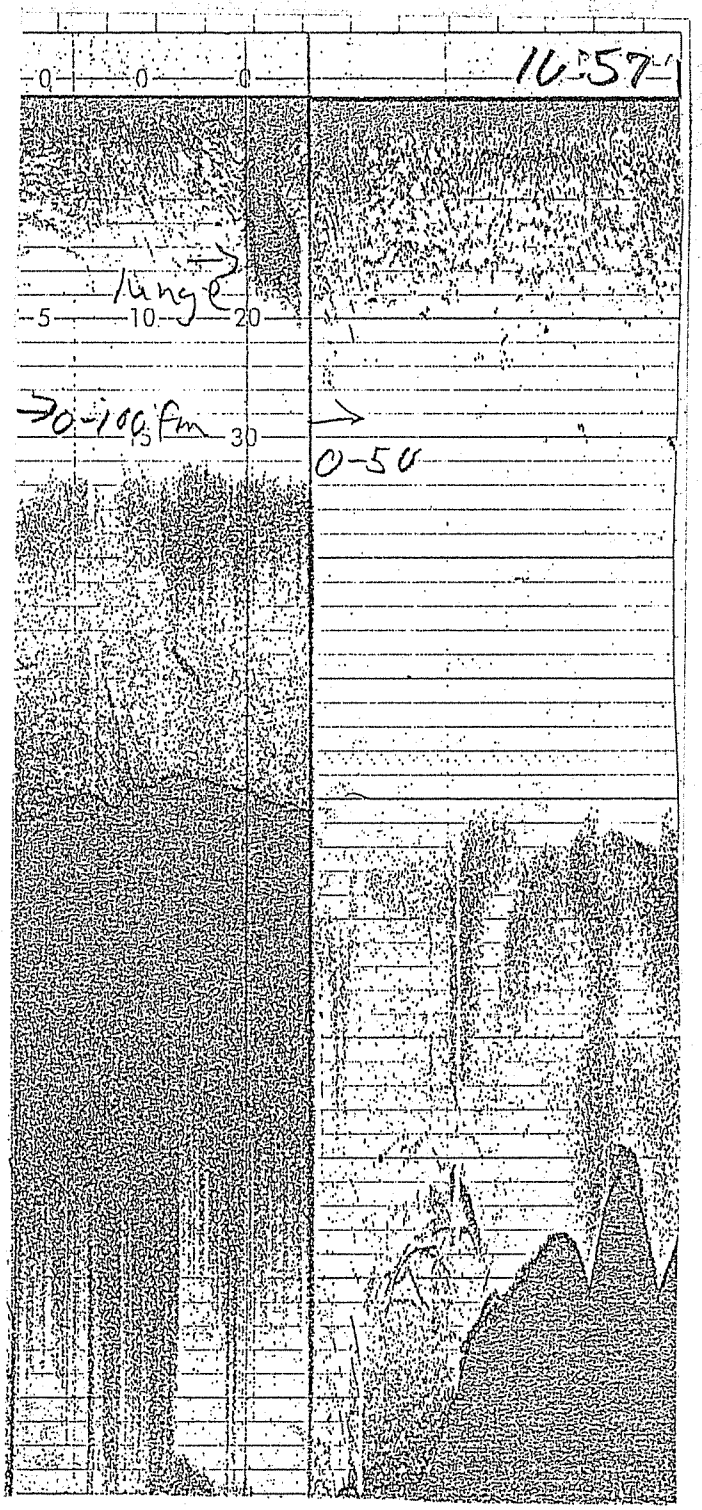

Figure 5: Fathometer recording from the path of #221 nearshore and north of Point Carolus on July 3, 1986. Scale 0 to 25 fathoms and gain reduced to 5 to discriminate the bottom through the dense concentration of prey.

Figure 6: Fathometer recording from the path of three whales (Quits, #155, and #351), in the mouth of Bartlett Cove on July 14, 1986. Scale 0 to 50 fathoms and gain set at 7.

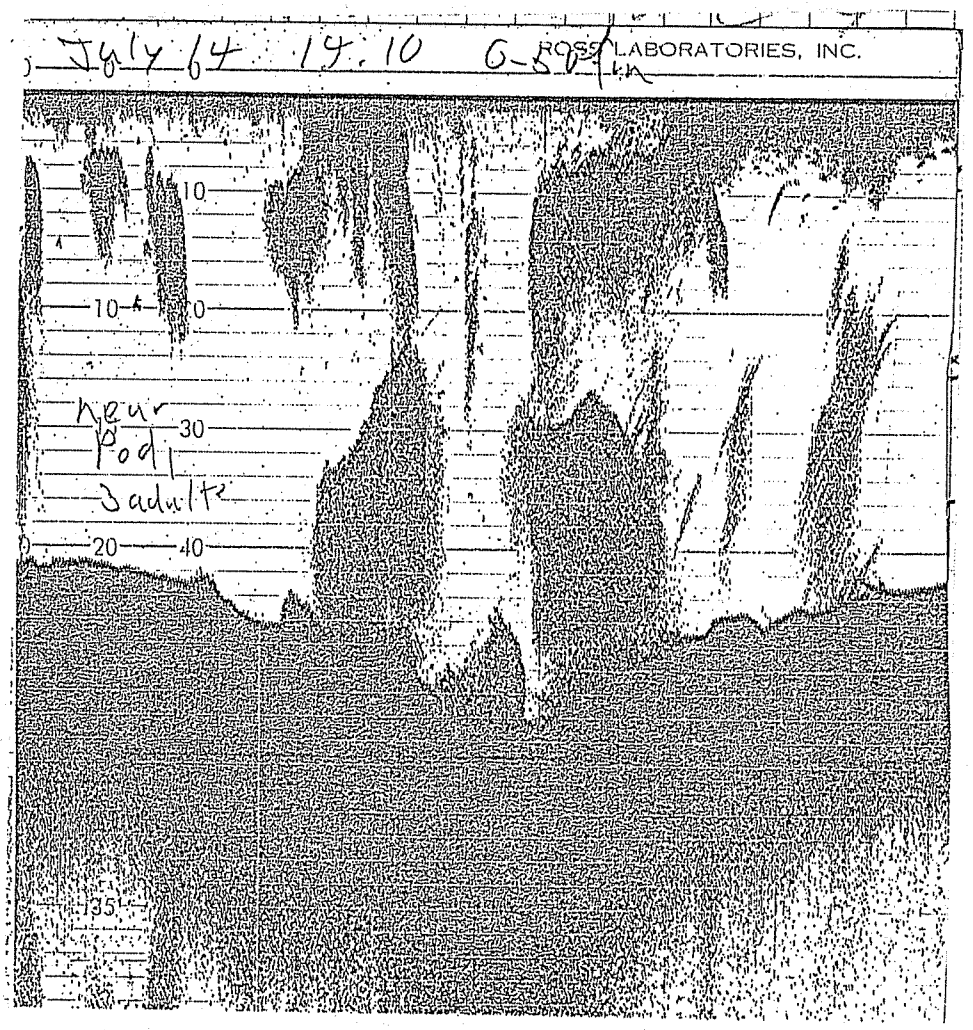

Figure 7: Fathometer recording made near Point Carolus on July 29, 1986, after the departure of the most whales from the area. Scale 0 to 50 fathoms and gain set at 7.

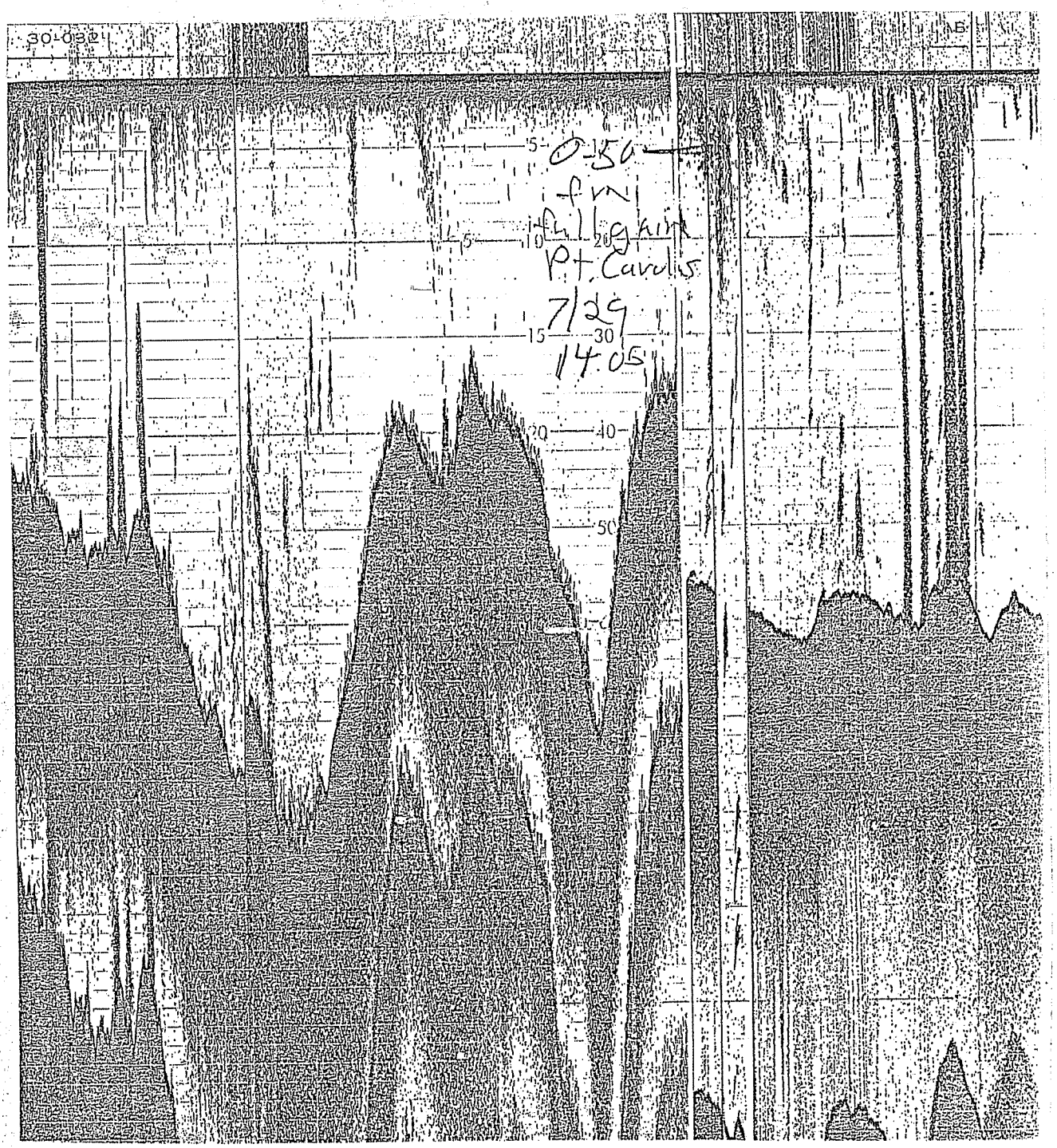

Figure 8: Fathometer recording made in the path of feeding whales near Point Adolphus on June 10, 1986. Scale 0 to 50 fathoms and gain set at 7.

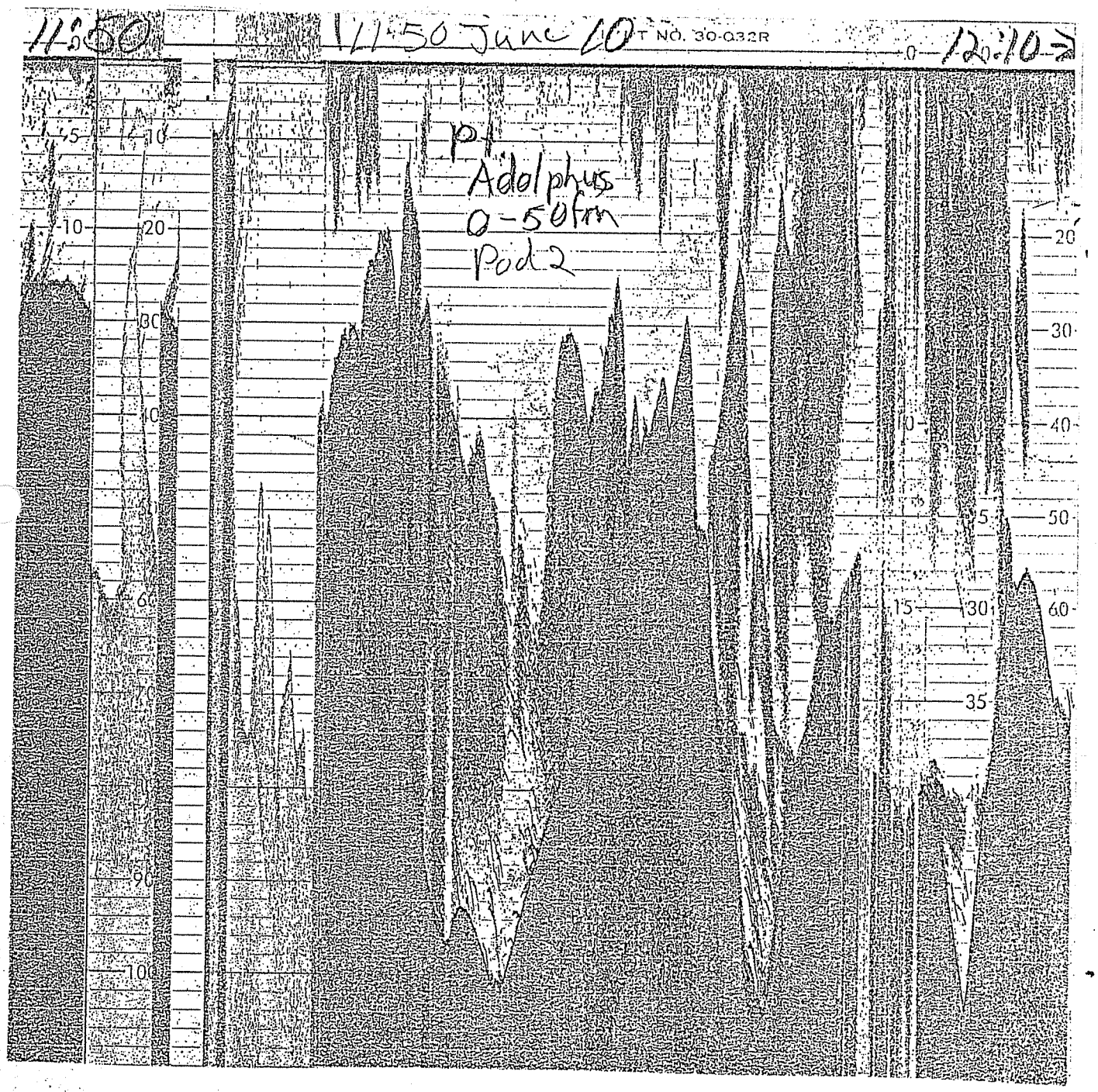

Figure 9: Fathometer recording made in the path of feeding whales near Point Adolphus on August 8, 1986. Scale 0 to 100 fathoms and gain set at 7.